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Longevity of the *Naja naja philippinensis* Under Stress of Venom Extraction

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(TEXT-FIGURES 1-3)

I. INTRODUCTION

IN order to ensure an adequate and uninterrupted supply of good quality venom of the Philippine cobra, *Naja naja philippinensis*, for antivenin production, the Serum and Vaccine Laboratories (SVL) in Alabang, Muntinlupa, Rizal, under the Bureau of Research and Laboratories, Republic of the Philippines, maintains a serpentarium. On a few occasions, requests for venom for medical and research purposes have been received and have been accordingly filled. The presence of cobras in the laboratory has every now and then attracted visitors. They include foreigners and Filipinos, mostly students, laboratory workers, and laymen. Some of them seek information regarding cobra venom and cobra antivenin production while others merely wish to see the cobras out of curiosity.

The principal interest of the laboratory, besides maintaining an adequate supply of the venom, is to find out how long the cobras usually live in captivity and how the stress of venom extraction affects their longevity. It is expected that the information gained in our serpentarium will make it possible to prolong the life expectancy of these animals and increase their lifetime venom yields under the conditions at the SVL serpentarium. This study was conceived and carried out for that purpose.

A review of the literature for the longevity of cobras under the specific conditions to which cobras kept in serpentaria for their venom are subjected has yielded negative results. References encountered so far regarding longevity of snakes are those of Baker (1951), Loveridge (1946), and Schmidt & Inger (1957).

Baker recorded a captive Pacific rattlesnake (family *Crotalidae*) that lived for 20 years, but doubted that wild ones could reach such age. He further stated that few diamondbacks (genus *Crotalus*) live past the first winter. Loveridge states that apparently the record of longevity for cobras kept in captivity is held by the two specimens which lived for 13 years at the New York Zoological Park. Schmidt and Inger state that the greatest age on record for the reticulated python *(Python reticulatus)* is 21 years; for the Indian python *(Python molurus)*, 17 years; for the African python *(Python sabae)*, about 15 years. In captivity, the diamond python *(Morelia argus)* is known to live a little more than 4 years.

J. H. Mason,[1] superintendent of the serum department, South African Institute for Medical Research, speaking about their serpentarium, states that they milk their snakes once every fortnight and that "the death rate is rather high as is usual when snakes are crowded together and milked frequently."

Cobras, like most wild animals, are very nervous especially when confined in limited enclosures in relatively great numbers. As in the case with our serpentarium, where they have to be maintained to ensure a continuous supply of venom for immunization, many have even refused to eat and literally starved themselves to

[1]Personal communication, 1957.

death. The presence of men, cobra tenders and visitors, and frequent handling for venom extraction all contribute to increased irritation. All these factors, especially the latter, seem to exhaust them and shorten their lives.

II. Materials and Methods

A total of 2,075 cobras, *Naja naja philippinensis,* were observed to supply the data for this paper. These were collected during the period December 3, 1959, through April 16, 1963. Except for occasional specimens caught within and around the laboratory premises, all were from the province of Camarines Sur, Island of Luzon.

No attempt was made to determine the ages of the specimens used inasmuch as no information which may be used as a practical age indicator was available to the author. Only specimens 36 inches or more in apparent good health and with intact fangs were used in this study. These were caught in a manner to avoid any injury to them. The maximum size noted was 59 inches with an average length of 42.73 inches among 393 specimens measured at random.

A. Care and Management

The care and management of the cobras at the SVL serpentarium conform with the facilities available and the specific purpose for which they are maintained.

1. *Housing.*—The laboratory maintains two roofless enclosures for housing these snakes. The larger one measures 44.3 feet by 27.3 feet, surrounded by a four-foot-high concrete wall and five-foot-high reinforced half-inch mesh wire screen atop the concrete wall. The inner surface of the wall inclines inward so that a plumb line dropped from the inner surface of the upper end of the wall falls about four inches from the inner surface of the bottom of the wall. The walls have a two-and-a-half-inch overhang all around the inside.

In the center is a rectangular tiled trough, 77 inches by 58 inches and 5 inches deep, which is filled with water from a fountain. Here the snakes usually water themselves after venom extraction and at other times. Along the base of the walls inside the enclosure is a concrete strip 15½ inches wide. On this are distributed blocks 16 inches by 8 inches by 4 inches in dimension. Each block has twin hollows, 2 inches by 5½ inches by 8 inches. In these hollows, where it is generally cool and dark, the snakes remain most of the time. The rough surface and corners of the blocks provide convenient anchors for their skin when they start to molt.

The smaller enclosure measures 22.6 by 25.3 feet. The surrounding wall is 3.7 feet high with a 9-inch overhang on the inside. The reinforced wire screen atop the wall is 3.8 feet high.

The tiled trough in the center is 35 inches square and 3.6 inches deep. It is filled with water from a fountain in its center. Hollow blocks are also provided as in the larger enclosure.

2. *Feeding.*—White mice are made available on the days following venom extraction for the snakes to feed as they please.

3. *Collection of the venom.*—The preparatory steps employed for controlling the snake have been described elsewhere (De Leon & Salafranca, 1956).

The cobra is grasped gently but firmly by the neck behind the angles of the jaw, with the thumb and index finger assisted by the remaining fingers of the left hand. The tail end is controlled by the third and small fingers of the right hand, with the thumb, index, and first fingers holding the beaker for venom collection. The latter is a "Pyrex" 100 ml. (50 × 65 mm.) beaker. A rubber diaphragm, a circular piece of all-rubber surgical sheeting or the intact portions of discarded inner tube (26″ × 2.125″) of a bicycle tire of appropriate diameter, is tautly secured across the opening of the beaker with a piece of strong cotton twine. The diaphragm prevents the fangs from jamming against the wall of the beaker during the bite and thus prevents them from breaking off, and because the snake is not hurt in the process it bites more fully and holds the bite longer than with the method and collection apparatus previously employed (De Leon & Salafranca, *ibid.*). The diaphragm also prevents contamination of the venom with saliva, soil, and other debris present in the mouth of the snake.

As the beaker is brought opposite the snake's head, the cobra generally opens its mouth and voluntarily bites. At times it appears to be so eager to do so that venom spurts before it actually bites (the *Naja naja philippinensis* is a "spitting" cobra). The fangs pierce the rubber diaphragm and the venom may spurt out in a fine stream with enough force to cause previously collected venom in the beaker to froth, followed by a few drops, or a trickle may be noted along the wall of the beaker, or it may come out in isolated drops.

Venom was collected once fortnightly, except as indicated in the following controlled experiments:

I. *Effect of different schedules of venom extraction on longevity.*—In order to determine the effect, if any, of the frequency of venom extraction on longevity, replicate experiments were

conducted on comparable groups of cobras, which were subjected to different schedules of venom extraction.

In the first experiment a batch of 114 cobras was divided at random into three groups of 38 each. Venom was extracted once a week from the first group, once in two weeks from the second group, and once in three weeks from the third group. All the snakes were allowed to move freely in the larger enclosure and venom collected according to the schedule indicated until all of the specimens died. Color bands were painted on the snakes to identify the different groups.

A second experiment and a third, following exactly the same plan, were conducted with a batch of 192 cobras divided at random into three groups of 64 snakes, and another batch of 90 divided into three groups of 30 (Table I, Fig. 1).

TABLE I.
RELATION BETWEEN LONGEVITY AND THREE SCHEDULES OF VENOM EXTRACTION

Experiment Number	*Schedule of Venom Extraction*		
	A Once a week	B Once in 2 weeks	C Once in 3 weeks
Experiment I 38 cobras per schedule	39.79*	51.53	59.03
Experiment II 64 cobras per schedule	56.06	94.35	123.81
Experiment III 30 cobras per schedule	48.70	63.63	84.40
Over-all averages	48.18	69.84	89.08

*The figures under each schedule in each experiment are expressed in number of days and represent the arithmetic average of all the respective data collected.

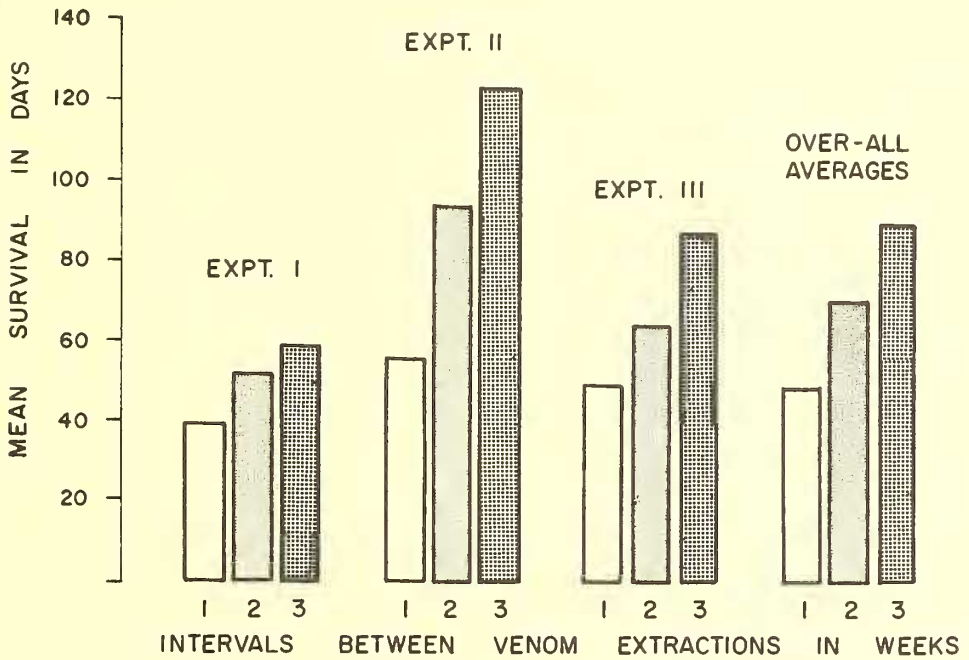

FIGURE 1 COMPARATIVE MEAN LONGEVITY OF COMPARABLE GROUPS OF COBRAS UNDER THREE SCHEDULES OF VENOM EXTRACTION IN THREE EXPERIMENTS

II. *Comparative longevity of cobra under stress of venom extraction and of those from which no venom was extracted.*—A batch of 40 cobras was divided at random into groups of 33 and 7, respectively. From the first group, venom was extracted fortnightly; from the second no venom was extracted. The number of cobras in the second group was kept as small as possible mainly for economy reasons. All were kept in the same enclosure under the same conditions until all had died. The comparative data are presented in Table II.

III. *Death rate and time (month) of the year.*—To determine any possible relation between the time of the year and the death rate, beginning-of-the-month inventories were determined starting with December, 1959, through July, 1963. Any acquisition during the month was added to the corresponding inventory to arrive at the monthly population figure. The total number of deaths during the month was determined and the monthly mortality rates were computed over a period of 43 months, January, 1960, through July, 1963 (Fig. 3).

In going over these observations and evaluating the data collected, one must be reminded of the possible error which a greater or lesser percentage of carry-over of the specimens from one month to the other, and consequently the relative ages of the specimens carried over from month to month, may have on the resulting percentages.

IV. *Longevity and time of collection.*—In an attempt to determine whether the time of the year the snakes were collected had any influence on their subsequent longevity, the data on all the batches included in this study and which were subjected to a uniform, fortnightly schedule of venom extraction were compiled and are presented in Table III for this purpose.

Table II.
Longevity of Cobras Under Stress of Extraction Compared with Those from Which No Venom Was Extracted

Group	*Number of Cobras*	*Schedule of Venom Extraction*	*Longevity in Days*		
			Minimum	Maximum	Mean
I	33	Once in 2 weeks	39	118	74.90
II	7	No venom extraction	31	226	149.14

Table III.
Longevity in Batches of *Naja naja philippinensis*, All Subjected to Fortnightly Venom Extraction

Number	*Date of Arrival*	*Total No. Specimens*	*Minimum*	*Maximum*	*Mean*
I	December 3, 1959	229	5	147	94.67
II	March 8, 1960	491	2	202	87.86
III	June 7, 1960	555	2	175	84.31
IV	October 17, 1960	38	13	94	51.56
V	December 22, 1960	65	41	131	91.58
VI	February 9, 1961	30	7	90	50.70
VII	June 21, 1961	55	7	91	50.70
VIII	September 6, 1961	109	12	120	64.04
IX	December 22, 1961	24	31	105	82.79
X	January 29, 1962	29	74	142	102.31
XI	April 23, 1962	32	63	114	86.96
XII	June 25, 1962	32	57	131	83.78
XIII	September 4, 1962	29	23	118	54.28
XIV	November 4, 1962	15	63	97	73.33
XV	January 14, 1963	33	39	118	74.90
XVI	April 16, 1963	38	27	146	79.34
	Total	1,804			
	Over-all averages		28	127	76.49

B. Manner of Reckoning Longevity

The date of arrival and the number of the specimens in each batch were recorded. Every day the cobra tenders inspected their charges and noted any deaths. The first death in a given batch is designated as cobra number one, the second, number two, and so on. The total number of days each survived (from the date of their arrival in the serpentarium) was recorded. When the last specimen in the batch died, the arithmetic mean longevity was determined. A total of 16 batches were involved in this study.

III. Results and Discussions

Table I summarizes the results obtained in replicate experiments comparing the effects of the three schedules of venom extraction on the longevity of the cobras. The data collected in each case are expressed as the arithmetic average of all the respective observations. An inspection of the averages shows a definite increase in longevity as the frequency of the extraction decreases.

The differences observed in longevity in experiments I, II, and III between groups 1 and 2 and between 1 and 3 were analyzed statistically and were found to be significant.

Figure 1 is a graphic interpretation of the data presented in Table I.

The results of the experiments to demonstrate the difference in longevity in two comparable groups of cobras—group I, from which venom was extracted fortnightly, and group II, from which no venom was extracted at all—are presented in Table II. The mean longevity obtained for group II is for practical purposes twice that obtained for group I.

Figure 2 gives a graphic picture of the combined data in Tables I and II. It clearly shows that venom extraction adversely affects longevity and

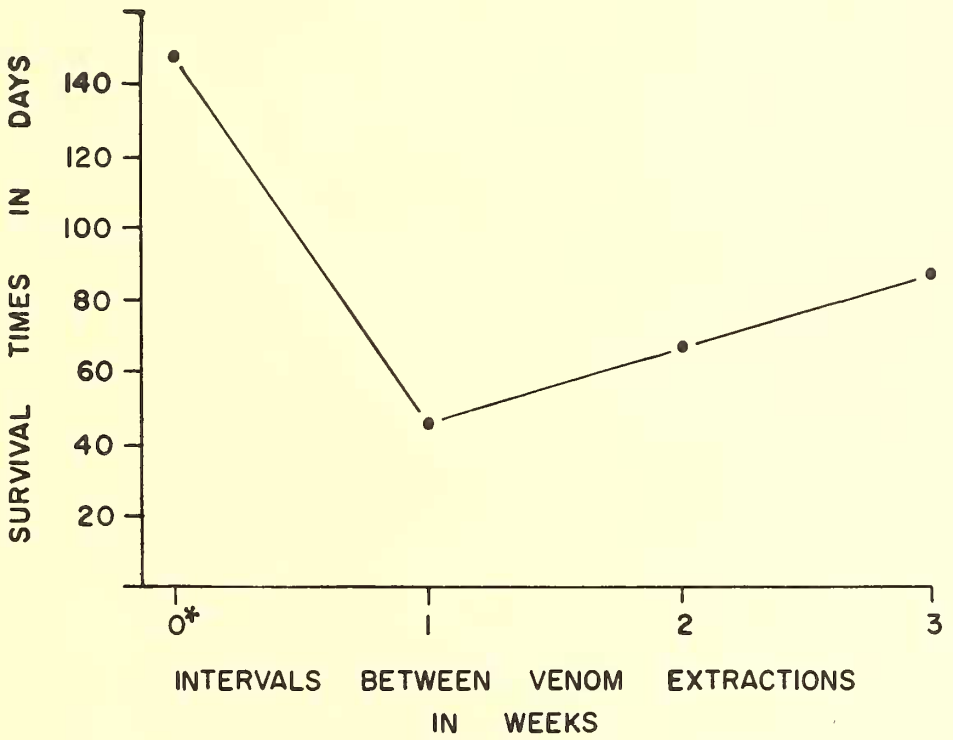

FIGURE 2 LONGEVITY OF COBRAS IN RELATION TO THE FREQUENCY OF VENOM EXTRACTION

* NO VENOM EXTRACTION

that the degree to which longevity is adversely affected is directly proportional to the frequency of venom extraction.

To better appreciate the monthly death rates and their trends and facilitate an interpretation on the basis of observations made, both in the serpentarium and in the fields during hunting trips, Figure 3 has been prepared. It gives the monthly mortality rate percentage computed on the basis of cumulative monthly populations and the cumulative monthly deaths covering a period of 43 consecutive months, January, 1960, to July, 1963.

In presenting the following interpretations of Figure 3 the possible source of error mentioned above has been kept in mind and only those supported by observations made both in the serpentarium and in field trips are made:

1. Considering that, generally, June to November is our rainy season and December to May our dry season, we have higher death rates during the "wet" than during the "dry" season. From the data obtained we get an over-all average death rate of 35.3% for the former and 19.3% for the latter. Death rates are lower during the cooler part of the "dry" season, December to February, than during the warmer part, March to May, reaching a peak in the latter month.

2. The slump in death rate in June may be explained by the cooling effect of the first mild rains of late May and early June.

In the serpentarium the only protected spaces to which the cobras have access are the hollows of the cement blocks, which offer limited insulation to extremes of temperature and very little protection to drenching rains. The earliest rains experienced during late May offer relief from the usually scorching heat, which reaches a peak by May. This offers a logical explanation for the sudden drop in death rate noted. With more and heavier rains the earth becomes soggy, water becomes stagnant, and the hollow blocks are drenched. The skin of the snakes gets soaked and soft, making them, possibly, more vulnerable to systemic and skin diseases (as indicated by their noticeably rundown condition and dull roughened scales during this period). As the rainy season progresses there is noted a rise in mortality rate which reaches a peak in September.

3. As the rains abate toward the end of the "wet" season, a gradual decrease in the death rate is again noted.

Table III is a summary of the data on the

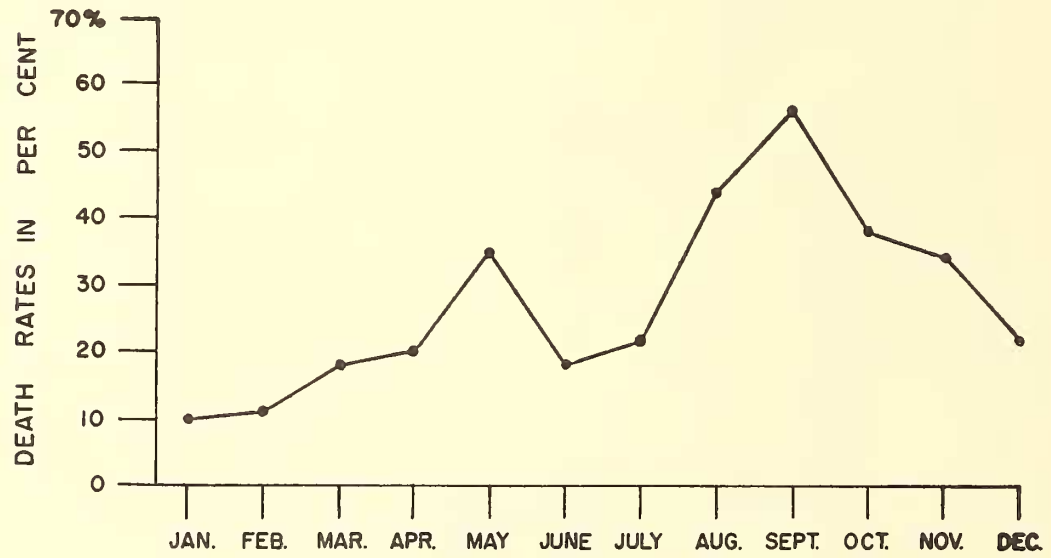

FIGURE 3 SHOWING THE TRENDS IN MONTHLY DEATH RATES

batches involved in this study, which were subjected to the uniform schedule of fortnightly venom extraction. From the data presented, there appears to be no relation between the month of the year the batches were acquired and the mean survival times of the respective batches.

IV. Summary and Conclusions

A total of 2,075 cobras were observed in the serpentarium of the SVL over a period of 43 months.

The data collected indicate that:

1. Longevity is adversely affected by the frequency of venom extraction; the more frequent the extraction, the shorter the span of life.

Under the conditions at the SVL serpentarium, cobras not subjected to venom extraction that served as controls lived an average of 149.14 days. Individual longevities ranged from 31 to 226 days.

Snakes from which venom was extracted once in 21 days lived an average of 89.08 days, or 61% as long as the controls. Those from which venom was extracted once every 14 days lived an average of 69.84 days, or 46% as long as the controls. Snakes from which venom was extracted every 7 days lived an average of 48.18 days, or 32% as long as the controls.

2. Monthly death rates computed on the basis of cumulative monthly population and the corresponding deaths over a period of 43 months indicate two peaks, the lesser peak occurring in May, or about the height of the dry season, and the greater peak in September, corresponding to about the height of the rainy season.

3. An over-all average longevity of 76.49 days was obtained from the data on 1,804 specimens uniformly subjected to fortnightly venom extraction. Individual longevities ranged from 2 to 202 days.

4. The time (month) of the year a batch of specimens was collected does not appear to bear any direct relation to the mean survival time of that particular batch.

5. The severe rains increased monthly mortality rates more than the extreme heat experienced during the period of this study.

V. Acknowledgments

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